

CLAIMS

WHAT IS CLAIMED:

1. A method for determining critical dimension variation, comprising:  
providing a wafer having a grating structure comprising a plurality of lines;  
5 illuminating at least a portion of the lines with a light source;  
measuring light reflected from the illuminated portion of the lines to generate a  
reflection profile; and  
determining a critical dimension variation measurement of the lines based on the  
reflection profile.
- 10 2. The method of claim 1, wherein determining the critical dimension variation  
measurement further comprises:  
comparing the generated reflection profile to a library of reference reflection profiles,  
each reference reflection profile having an associated critical dimension  
15 variation metric;  
selecting a reference reflection profile closest to the generated reflection profile; and  
determining the critical dimension variation measurement based on the critical  
dimension variation metric associated with the selected reference reflection  
profile.
- 20 3. The method of claim 1, further comprising determining at least one parameter  
of an operating recipe of a polishing tool adapted to polish a subsequent wafer based on the  
reflection profile.

4. The method of claim 3, wherein determining at least one parameter of the operating recipe of the polishing tool comprises changing at least one of a polish time, a downforce parameter, and a polishing pad speed parameter.

5 5. The method of claim 3, wherein determining the at least one parameter of the operating recipe further comprises determining the at least one parameter of the operating recipe for a polishing process to be performed on a shallow trench isolation region of the subsequent wafer.

10 6. The method of claim 1, wherein generating the reflection profile comprises generating the reflection profile based on at least one of intensity and phase of the reflected light.

15 7. The method of claim 1, wherein providing the wafer comprises providing the wafer having the grating structure formed in a test structure on the wafer.

8. The method of claim 1, wherein providing the wafer comprises providing the wafer having the grating structure formed in a production device on the wafer.

20 9. The method of claim 1, wherein determining the critical dimension variation measurement further comprises:

comparing the generated reflection profile to a target reflection profile; and

determining the critical dimension variation measurement based on the comparison of the generated reflection profile and the target reflection profile.

10. The method of claim 1, further comprising identifying a fault condition associated with the lines based on the reflection profile.

11. A method for determining critical dimension variation, comprising:

5 providing a wafer having a grating structure comprising a plurality of lines;

illuminating at least a portion of the lines with a light source;

measuring light reflected from the illuminated portion of the lines to generate a reflection profile; and

comparing the generated reflection profile to a library of reference reflection profiles,

each reference reflection profile having an associated critical dimension variation metric;

selecting a reference reflection profile closest to the generated reflection profile; and

determining a critical dimension variation measurement of the lines based on the critical dimension variation metric associated with the selected reference reflection profile.

12. The method of claim 11, further comprising determining at least one parameter of an operating recipe of a polishing tool adapted to polish a subsequent wafer based on the reflection profile.

13. The method of claim 12, wherein determining at least one parameter of the operating recipe of the polishing tool comprises changing at least one of a polish time, a downforce parameter, and a polishing pad speed parameter.

14. The method of claim 12, wherein determining the at least one parameter of the operating recipe further comprises determining the at least one parameter of the operating recipe for a polishing process to be performed on a shallow trench isolation region of the subsequent wafer.

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15. The method of claim 11, wherein generating the reflection profile comprises generating the reflection profile based on at least one of intensity and phase of the reflected light.

16. The method of claim 11, wherein providing the wafer comprises providing the wafer having the grating structure formed in a test structure on the wafer.

17. The method of claim 11, wherein providing the wafer comprises providing the wafer having the grating structure formed in a production device on the wafer.

18. The method of claim 11, further comprising identifying a fault condition associated with the lines based on the reflection profile.

19. A method for determining critical dimension variation, comprising:

providing a wafer having a grating structure comprising a plurality of lines;

illuminating at least a portion of the lines with a light source;

measuring light reflected from the illuminated portion of the lines to generate a

reflection profile; and

comparing the generated reflection profile to a target reflection profile; and

determining a critical dimension variation measurement of the lines based on the comparison of the generated reflection profile and the target reflection profile.

20. The method of claim 19, further comprising determining at least one parameter of an operating recipe of a polishing tool adapted to polish a subsequent wafer based on the reflection profile.

21. The method of claim 19, wherein determining at least one parameter of the operating recipe of the polishing tool comprises changing at least one of a polish time, a downforce parameter, and a polishing pad speed parameter.

22. The method of claim 19, wherein determining the at least one parameter of the operating recipe further comprises determining the at least one parameter of the operating recipe for a polishing process to be performed on a shallow trench isolation region of the subsequent wafer.

23. The method of claim 19, wherein generating the reflection profile comprises generating the reflection profile based on at least one of intensity and phase of the reflected light.

24. The method of claim 19, wherein providing the wafer comprises providing the wafer having the grating structure formed in a test structure on the wafer.

25. The method of claim 19, wherein providing the wafer comprises providing the wafer having the grating structure formed in a production device on the wafer.

26. The method of claim 19, further comprising identifying a fault condition associated with the lines based on the reflection profile.

5 27. A metrology tool adapted to receive a wafer having a grating structure comprising a plurality of lines, comprising:

a light source adapted to illuminate at least a portion of the lines;

a detector adapted to measure light reflected from the illuminated portion of the lines to generate a reflection profile; and

10 a data processing unit adapted to determine a critical dimension variation measurement of the lines based on the reflection profile.

15 28. The metrology tool of claim 27, wherein the data processing unit is further adapted to compare the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated critical dimension variation metric, select a reference reflection profile closest to the generated reflection profile, and determine the critical dimension variation measurement based on the critical dimension variation metric associated with the selected reference reflection profile.

20 29. The metrology tool of claim 27, wherein the detector is further adapted to generate the reflection profile based on at least one of intensity and phase of the reflected light.

25 30. The metrology tool of claim 27, wherein the metrology tool comprises at least one of a scatterometer, an ellipsometer, and a reflectometer.

31. The metrology tool of claim 27, wherein the grating structure comprises a test structure.

5 32. The metrology tool of claim 27, wherein the grating structure comprises a portion of a production device formed on the wafer.

33. The metrology tool of claim 27, wherein the data processing unit is further adapted to compare the generated reflection profile to a target reflection profile and determine the critical dimension variation measurement based on the comparison of the generated reflection profile and the target reflection profile.

34. A processing line, comprising:  
a polishing tool adapted to polish wafers in accordance with an operating recipe;  
a metrology tool adapted to receive a wafer having a grating structure comprising a plurality of lines, the metrology tool comprising:

a light source adapted to illuminate at least a portion of the lines;

a detector adapted to measure light reflected from the illuminated portion of the lines to generate a reflection profile; and

a data processing unit adapted to determine a critical dimension variation measurement of the lines based on the reflection profile; and

a process controller adapted to determine at least one parameter of the operating recipe of the polishing tool based on the determined critical dimension variation measurement.

35. The processing line of claim 34, wherein the data processing unit is further adapted to compare the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated critical dimension variation  
5 metric, select a reference reflection profile closest to the generated reflection profile, and determine the critical dimension variation measurement based on the critical dimension variation metric associated with the selected reference reflection profile.

36. The processing line of claim 34, wherein the detector is further adapted to  
10 generate the reflection profile based on at least one of intensity and phase of the reflected light.

37. The processing line of claim 34, wherein the metrology tool comprises at least  
15 one of a scatterometer, an ellipsometer, and a reflectometer.

38. The system of claim 34, wherein the grating structure comprises a test  
structure.

39. The system of claim 34, wherein the grating structure comprises a portion of a  
20 production device formed on the wafer.

40. The processing line of claim 34, wherein the data processing unit is further adapted to compare the generated reflection profile to a target reflection profile and determine the critical dimension variation measurement based on the comparison of the  
25 generated reflection profile and the target reflection profile.

41. The processing line of claim 34, wherein the process controller is further adapted to change at least one of a polish time, a downforce parameter, and a polishing pad speed parameter in the operating recipe.

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42. The processing line of claim 34, wherein the polishing tool is adapted to polish a shallow trench isolation region of a subsequent wafer based on the determined operating recipe parameter.

43. A metrology tool adapted to receive a wafer having a grating structure comprising a plurality of lines, comprising:

a light source adapted to illuminate at least a portion of the lines;

a detector adapted to measure light reflected from the illuminated portion of the lines to generate a reflection profile; and

a data processing unit adapted to compare the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated critical dimension variation metric, select a reference reflection profile closest to the generated reflection profile, and determine a critical dimension variation measurement of the lines based on the critical dimension variation metric associated with the selected reference reflection profile.

44. A metrology tool adapted to receive a wafer having a grating structure comprising a plurality of lines, comprising:

a light source adapted to illuminate at least a portion of the lines;

a detector adapted to measure light reflected from the illuminated portion of the lines  
to generate a reflection profile; and  
a data processing unit adapted to compare the generated reflection profile to a target  
reflection profile and determine a critical dimension variation measurement of  
the lines based on the comparison of the generated reflection profile and the  
target reflection profile.

45. A processing line, comprising:

means for receiving a wafer having a grating structure comprising a plurality of lines;  
means for illuminating at least a portion of the lines with a light source;  
means for measuring light reflected from the illuminated portion of the lines to  
generate a reflection profile; and  
means for determining a critical dimension variation measurement of the lines based  
on the reflection profile.

46. The processing line of claim 45, further comprising:

means for comparing the generated reflection profile to a library of reference  
reflection profiles, each reference reflection profile having an associated  
critical dimension variation metric;  
means for selecting a reference reflection profile closest to the generated reflection  
profile; and  
means for determining the critical dimension variation measurement based on the  
critical dimension variation metric associated with the selected reference  
reflection profile.

47. The processing line of claim 45, further comprising:  
means for comparing the generated reflection profile to a target reflection profile; and  
means for determining the critical dimension variation measurement based on the  
comparison of the generated reflection profile and the target reflection profile.

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